BUILDING MATERIAL QUALITY CONTROL DURING CONSTRUCTION

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Abstract:- **Quality means excellence. It is thus a philosophy rather than a mere attribute. The difference between two objects is judged by their qualities. We set some standards which determine the level of acceptability. In most industries especially in manufacturing and process industry, the concept of quality management is old and used extensively. Nowadays, application of quality management is not only becoming popular but also mandatory in construction industry.**

Keywords: **qualities, philosophy**

1. INTRODUCTION

Just knowing some quality control methods or procedures will not do any good. We must have to adopt and implement the quality control methods and tools that are available to us. The concept and its practice must be tuned in harmoniously.

Quality assurance in construction activities guides the use of correct structural design, specifications and proper materials ensuring that the quality of workmanship by the contractor /sub-contractor is achieved and finally maintaining the structure after construction is complete through periodic assessments for maintenance and repairs. Quality control has to be imposed by the contractor whereas quality assurance is carried out by a separate third party agency engaged by the owner.

I.T. Park, Doon Square Mall at Dehradun, Uttarakhand is being constructed by M/s Supertech Ltd. For this site M-30 grade of concrete suitable for pumped concrete is required. Aggregates for construction was stored at site. Its analysis report is given in Table 2.For laboratory trial 5 brands of PPC cement bags were taken from local market. They were identified as cement brand, 1, 2, 3, 4 and 5. Two reputed brands of normal super plasticizers based on sulphonated naphthalene formaldehyde (SNF) were taken for trials. They were identified as SP (A) and SP (B) to find their compatibility with the given 5 brands of PPC cement identified as cement brand 1, 2, 3, 4 and 5.

2. COMPATIBILITY

The behavior of concrete in the presence of super plasticizers is related to the amount and type of sulfate added to the clinker. The rheological and setting Behavior are changed depending on whether the sulfate is added as anhydrite, hemihydrates, or gypsum. The difference is explained by the different rates of dissolution of these sulfates. It is also important to note that all admixtures belonging to the same generic type may not behave similarly in concrete because of the variations in the molecular weight, cautions associated with them, chain length, etc. Similarly the same type of cement generically may be different in mineral, alkali and sulfate contents, and fineness.

As per IS: 456-2000 Admixture should not impair durability of concrete nor combine with the constituent to form harmful compounds nor increase the risk of corrosion of reinforcement. The workability, compressive strength and the slump loss of concrete with an without the use of admixtures shall be established during the trial mixes before use of admixtures. If two or more admixtures are used simultaneously in the same concrete mix, data should be obtained to assess their interaction and to ensure their compatibility.

The performance of concrete admixtures including superplasticizers depends upon the admixtures and concrete making materials and their compatibility. It is necessary to evaluate concrete admixtures for specific use with the concrete – making materials and mix proportions to be used on the work under actual field conditions.

Cement is composed of four major compounds, namely, C_3s, C_2s, C_3A and C_4AF. In additions, a number of minor oxide such as K_2O and Na_2O, MgO and SO_3 – which is contributed by gypsum, which is added in the final stages of cement manufacture as a set regulator. When there is less C_3A available, super plasticizer would tend to get absorbed in higher amount on C_3S and C_2S, resulting in a reduction in the strength development.

Table 1 : Superplasticing chemicals
Ref.: 1

S.No.	Class	Origin	Relative cost
1.	Lignosulphonates	Derived from neutralization, precipitation, and fermentation processes of the waste liquor obtained during production of paper-making pulp from wood	1
2.	Sulphonated melamine formaldehyde (SMF)	Manufactured by normal resinification of melamine – formaldehyde	4
3.	Sulphonated naphthalene formaldehyde (SNF)	Produced from naphthalene by oleum or SO3 sulphonation; subsequent reaction with formaldehyde leads to polymerization and the sulphonic acid neutralized with sodium hydroxide or lime	2
4.	Polycarboxylic ether (PCE)	Free radical mechanism using peroxide initiators is used for polymerization process in these systems	

3. MIX DESIGN DETAILS

1. As per IS: 456-2000, M-30 grade of concrete design for a mean target strength of

$30 + 1.65 \times 5 = 38.3$ N/mm^2
at 28 days age

2. Workability (a) Mix with NO admixture, only for comparison

Slump $\pm$ 40 mm
(b) Mix with super plasticizer for pumped concrete slump $\pm$90 mm.
Pouring time within 40 minutes.

3. From many laboratory trials, the following mix design identified for final trials.

M-30 grade of concrete quantity of materials per cu.m of concrete on the basis of saturated and surface dry aggregates.

1. Water = 180 kg/m^3
2. Cement, PPC = 410 kg/m^3
3. Sand = 750 kg/m^3
4. 5 mm crushed aggregate = 500 kg/m^3
5. 20 mm crushed aggregate = 540 kg/m^3
6. Normal super plasticizer = 5.800 kg/m^3

Total = 2385.8 kg/m^3
Note: With cement brand No. 3 and SP (B) 28 – days laboratory cubes average density found to be 2394 kg/m^3.

4. All the 150 mm cube samples are the average of 3 cubes and they are within $\pm$ 15% of the average value.
5. For conclusion of Lab trials the cubes compressive strength is given in Table 3.
6. The mix design is carried out from references 2 and 3.
7. The above given design mix is used in all the Lab trial mixes. The same design mix along with cement brand 3 with super plasticizer (B) is followed in the construction. Site cube results are given in Table 4.

4. PREPARATION OF QUALITY CONCRETE

Quality control means rational use of resources. Quality control procedures implement appropriate mixing, proper compaction, correct placement and adequate curing. Quality control prevents temptation of over design.Quality control ensures strict monitoring of every stage of concrete production and rectification of faults.

Quality control reduces maintenance costs. A typical flow chart showing various steps of concrete mixing is shown in Figure 1. This chart is adapted from the Quality Assurance Unit of New York City, Department of Transportation, Bureau of Bridges.

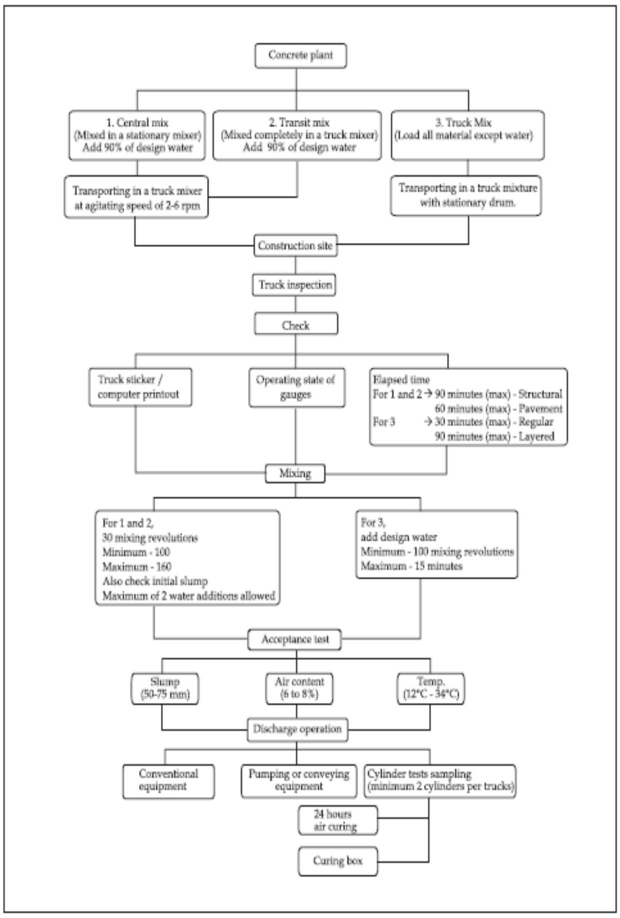

Figure 1 Flow Chart of Concrete Mixing

Forms shall be strong enough to prevent the fresh concrete from bulging and withstand the action of mechanical vibrators. No placement shall be done without the approval of the site engineer.

Forms shall be designed to resist the pressure resulting from plastic concrete (wt. 24 kn/m3) and a live load allowance of 2.5 kn/m2 on horizontal surfaces. If wooden forms are used, care must be taken to eliminate the formation of joints due to shrinkage of lumber. Forms shall be sufficiently tight to prevent leakage of mortar. Inadequate forms often cause bulges or deformations. The forms for slabs, beams and girders shall be cambered as indicated on the drawings. Forms shall be filleted for about 25 mm at all exposed corners.

Forms may be constructed of wood, metal or any other approved material. If any metal ties or anchorages are provided, it shall be so constructed that the embedded portion can be removed at least 50 mm from the surfaceof the concrete without injury to such surface. Upon removal of the forms, wire ties shall be cut back at least 6 mm from the face of the concrete with sharp chisels. All cavities produced by the removal of metal ties shall be filled with mortar. The surface film shall be repaired before setting occurs.

Forms to be reused shall be maintained in good condition as to retain its accuracy of shape, strength, rigidity water tightness and smoothness of surface. Unsatisfactory forms shall not be used. All form surfaces that will be in contact with the concrete should be coated with a release agent supplied by approved manufacturer or an approved material to prevent adhesion of concrete to the formwork.

5. VIBRATING

The vibrators should be capable of transmitting vibration in frequencies of not less than 3,500 impulses per minute. Vibrators shall be such that they will not separate the ingredients of the concrete. The concrete must be vibrated sufficiently to accomplish thorough consolidation, complete embedment of the reinforcement, produce smooth surfaces free from honeycombing and air bubbles. Vibration should be able to and to work the concrete into all angles and corners of the forms.

The vibrator shall not be used to push or distribute the concrete laterally. The vibrating element shall be inserted in the concrete mass at a depth sufficient to vibrate the bottom of each layer effectively, in as nearly a vertical position as practicable. It shall be withdrawn completely from the concrete before being advanced to the next point of application.

A sufficient number of vibrators shall be employed so that thorough consolidation is secured throughout the entire volume of each layer of concrete at the required rate of placement. Extra vibrators shall be on hand for emergency use.

A. CURING OF CONCRETE

The silicates and aluminates of cement react with water to form a binding medium which solidifies into a hardened mass. This reaction is termed hydration and is exothermic in nature. The object of curing is to keep concrete saturated until the originally water-filled space in the fresh cement paste has been filled to the desired extent by the products of hydration of cement.

For hydration to continue, the relative humidity inside the concrete has to be maintained at a minimum of 80%. If the relative humidity of the ambient air is that high, there will be little movement of water between the concrete and the ambient air and no active curing is needed to ensure continuation of hydration.

Prevention of the loss of water from the concrete is of importance not only because the loss adversely affects the development of strength, but also because it leads to plastic shrinkage, increased permeability and reduced resistance to abrasion.
Curing is of little importance with respect to structural strength except in the case of very thin members. On the other hand, the properties of concrete in the outer zone are greatly influenced by curing as it is the concrete in this zone that is subject to weathering, carbonation and abrasion. The permeability of the outer zone of concrete has a paramount influence on the protection of steel reinforcement from corrosion. It has been established that the loss of strength at 28 days seems to be directly related to the loss of water, which occurs during the first 3 days.

B. METHODS OF CURING

Continuous curing for a specified time, starting as soon as the surface of the concrete is no longer liable to damage is desirable. Such conditions can be achieved by continuous spraying or ponding or by covering the concrete with wet burlap. On inclined or vertical surfaces, soaking hoses can be used. If w/c is low, continuous wet curing is highly desirable.

The second method of curing is called water barrier method. The techniques used include covering the surface of the concrete with overlapping polyethylene sheeting. White sheeting is preferable because it has the advantage of reflecting of solar radiation in hot weather.

The third method is spraying curing compounds which form a membrane. It is obvious that the membrane must be continuous and undamaged. The timing of curing is also critical. The curing spray should be applied after bleeding has stopped. The optimum time is the instant when the free water on the surface of the concrete has disappeared so that water shine is no longer visible.

6. CONCLUSION

Causes for poor quality can be summarized as ignorance, poor materials, poor design, poor detailing, poor workmanship, improper quantity of cement, improper concrete mix, excess water, inadequate compaction, substandard forms, inadequate curing, inadequate cover, poor construction practices, poor supervision and above all lack of technical knowledge.

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